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14. ABSTRACT

As part of ONR's AESOP DRI, during August 2006 M. Gregg's research team surveyed turbulent mixing across Monterey Bay, sequentially profiling along a set of tracks and repeating each sequence for a half-daily tidal cycle, 12.4 hours. In addition, a 300 kHz Workhorse ADCP was installed to monitor currents at one place. The observations revealed an unexpectedly rich array of processes within the bay and on the adjacent upper shelf.

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Final Technical Report

Diapycnal Mixing in a Coastal Regime

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As part of ONR's AESOP DRI, during August 2006 M. Gregg's research team surveyed turbulent mixing across Monterey Bay, sequentially profiling along a set of tracks and repeating each sequence for a half-daily tidal cycle, 12.4 hours. In addition, a 300 kHz Workhorse ADCP was installed to monitor currents at one place. The observations revealed an unexpectedly rich array of processes within the bay and on the adjacent upper shelf.

Six tracks were run with Advanced Microstructure Profilers (AMP), all across the shelf break because the AMP can profile to 1100 m (Fig. 1). Nineteen tracks were run with Modular Microstructure Profilers (MMPs) that carry a pumped Sea-Bird CTD. In addition, a 300 kHz Workhorse ADCP was set on the bottom while we were in the bay.

The 300 kHz Workhorse revealed a steady mean flow into the bay superimposed on barotropic tides with maximum amplitudes of ±0.07 m s^{-1}. Analysis shows a strongly modal structure to the baroclinic tidal currents, with the dominant modes changing during the two-weekly tidal cycle. At times, shear in the modes dominated mixing in MMP runs over the Workhorse.

The first group of MMP profiles in the bay discovered vertical columns of intense acoustic backscatter. These were visible in the ship's 12 kHz echo sounder as well as our 120 kHz and 208 kHz BioSonics acoustics backscatter systems. From the sixth run along the track an MMP sampled one of the features, which we subsequently learned were large aggregations of fish, probably anchovies. As seen from the dissipation profiles, ε within this fish aggregation were several decades larger than in adjacent profiles outside the aggregation. These were the largest dissipation rates measured in the bay. Gregg worked with John Horne, UW School of Fisheries,

to begin an assessment of the biological and physical nature of the aggregations and the mixing they produce. A manuscript was submitted to the Journal of Physical Oceanography in Spring 2009, which has now been published. Gregg and Horne (2009) provided the first observations of turbulence within aggregations of fish, demonstrating that, in at least some cases, mixing efficiency is much lower than assumed by estimates that biomixing may be a major mixing process.

In addition to the large effect of the tides on mixing, we also found solitons, both as trains and individual upward pulses. We plan a separate paper about them as well as about the nature of tides in the bay, as well as one summarizing mixing across the bay and comparing it with that on other shelves, looking for common themes and parameterizations.

PUBLICATION

Gregg, M.C. and J.K. Horne, Turbulence, acoustic backscatter and pelagic nekton in Monterey Bay, *J. Phys. Oceanogr*, 39, 1097-1114, 2009.